Integrated Dual Channel Switch and LNA Module
2 - 6 GHz

Features

- Dual Channel Architecture
- Broadband: 2 - 6 GHz
- High Power Switch Handling (T_C = 105°C):
  43 dBm LTE 8 dB PAR (<10 s, single event)
  40 dBm LTE 8 dB PAR (Lifetime)
- Second LNA has Bypass Mode
- Rx High Gain Mode:
  Gain: 35 dB at 2.6 GHz, 34 dB @ 3.5 GHz
  NF: 1.2 dB at 2.6 GHz, 1.45 dB @ 3.5 GHz
  OIP3: 35 dBm
- Rx Low Gain Mode:
  Gain: 19 dB at 2.6 GHz, 19.5 dB @ 3.5 GHz
  NF: 1.2 dB at 2.6 GHz, 1.45 dB @ 3.5 GHz
  OIP3: 30 dBm
- Single 5 V Supply, 115 mA per channel
- Compatible with 1.8 V and 3.3 V logic
- Lead-Free 6 mm 40-Lead QFN Package
- RoHS* Compliant

Applications

- 5G Massive MIMO
- Wireless Infrastructure
- TDD-Based Communication Systems

Description

The highly integrated dual channel switch and LNA module includes two antenna switches and two 2-stage low noise amplifiers in a compact low cost 6 mm QFN package. The second stage LNAs can be bypassed. Mixed technologies are used to achieve high power handling, low noise figure, and low power consumption. The module only needs a single +5 V supply. T/R switch, LNA enable, and bypass function can be controlled with 1.8 V or 3.3 V logic.

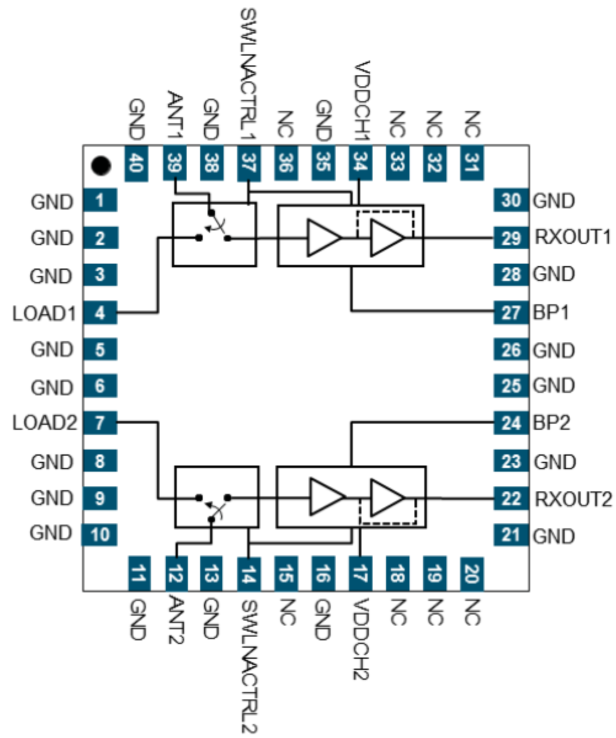
Ordering Information[1]

Part Number	Package
MAMF-011138-TR1000	1000 piece reel
MAMF-011138-001SMB	Sample Board

1. Reference Application Note M513 for reel size information.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Functional Schematic



Pin Configuration[2,3,4]

Pin #	Function
1-3, 5, 6, 8-11, 13, 16, 21, 23, 25, 26, 28, 30, 35, 38, 40	Ground
4	Load Ch1
7	Load Ch2
12	Antenna Input Ch2
14	Switch/LNA Enable Ch2
15, 18-20, 31-33, 36	No Connect
17	Switch/LNA V_{DD} Ch2
22	Rx Output Ch2
24	LNA Bypass Ch2
27	LNA Bypass Ch1
29	Rx Output Ch1
34	Switch/LNA V_{DD} Ch1
37	Switch/LNA Enable Ch1
39	Antenna Input Ch1

2. Blocking Capacitors are required on all RF Ports.
3. MACOM recommends connecting unused package pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Electrical Specifications: Freq. = 2.6 GHz, P_{IN} = -35 dBm, T_C = +25°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Conditions	Units	Min.	Typ.	Max.
Gain at Rx High Gain Mode	2.6 GHz 3.5 GHz 5.0 GHz	dB	31 30 29	35.0 34.0 32.5	—
NF at Rx High Gain Mode	2.6 GHz 3.5 GHz 5.0 GHz	dB	—	1.20 1.45 1.70	—
Input RL at Rx High Gain Mode	—	dB	—	15	—
Output RL at Rx High Gain Mode	—	dB	—	12	—
Output IP3 at Rx High Gain Mode	Tone Spacing = 10 MHz P_{OUT} / Tone = +3 dBm P_{OUT} / Tone = +10 dBm	dBm	—	33 35	—
Output P1dB at Rx High Gain Mode	—	dBm	—	19.5	—
Gain at Rx Low Gain Mode	2.6 GHz 3.5 GHz 5.0 GHz	dB	17 17 16	19.0 19.5 19.3	—
NF at Rx Low Gain Mode	2.6 GHz 3.5 GHz 5.0 GHz	dB	—	1.20 1.45 1.70	—
Input RL at Rx Low Gain Mode	—	dB	—	15	—
Output RL at Rx Low Gain Mode	—	dB	—	12	—
Output IP3 at Rx Low Gain Mode	Tone Spacing = 10 MHz Pout / Tone = +3 dBm	dBm	—	30	—
Output P1dB at Rx Low Gain Mode	—	dBm	—	15.5	—
Insertion Loss at Tx Mode	—	dB	—	0.35	0.8
Return Loss at Tx Mode	—	dB	—	25	—
Power Handling at Tx Mode	Average Power (8 dB PAR)	W	—	10	—
Supply Voltage	—	V	4.75	5	5.25
Control Voltage	Logic High Logic Low	V	1.2 0	—	3.45 0.6
Logic Input Current	Logic High Logic Low	µA	—	+80 -2	—
Supply Current (V_{DD}) per Channel	Rx High Gain Rx Low Gain Tx mode	mA	—	115 50 2	—

Electrical Specifications: Freq. = 2.6 GHz, P_{IN} = -35 dBm, T_C = +25°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Conditions	Units	Min.	Typ.	Max.
RF Switching Time	50% CTL to 10/90% RF	ns	—	500	—
High/Low Gain Mode Switching Time	50% CTL to 10/90% RF	ns	—	150	—
Isolation Between Rx Channels[5]	—	dB	—	42	—
Switch Isolation, ANT to Load	Rx Mode	dB	—	17	—
Switch Isolation, ANT to Rx output	Tx Mode	dB	—	66	—

5. Test conditions: both Rx channels are enabled. RF signal is present at Antenna port on one of the channels only. The isolation is defined as the difference between the 2 RX output signal levels.

Control Truth Table

LNASWCTRL1 / LNASWCTRL2 control management		
Logic Level	L or open	H
LNAs	ON	OFF
Switch	Antenna to RX	Antenna to Load
BP1 / BP2 control management		
Logic Level	L or open	H
Mode	No Bypass (HGM[6])	Bypass (LGM[7])

6. HGM: High Gain Mode.
7. LGM: Low Gain Mode.

Absolute Maximum Ratings[8,9]

Parameter	Absolute Maximum
Antenna Input Power[10] Freq. = 2.6 GHz: RX Mode TX Mode	 22 dBm LTE (8 dB PAR), 22 dBm CW 43 dBm LTE (8 dB PAR), 43 dBm CW
DC Voltages: ANT1/2, LOAD1/2, RXOUT1/2 VDDCH1/2, SWLNACTRL1/2,BP1/2	 -0.3 to +3.6 V -0.3 to +5.5 V -0.3 to +3.6 V
Junction Temperature: RX Mode[11,13] TX Mode[11,13] TX Mode[10]	 +150°C +125°C +140°C
Operating Temperature[12]	-40°C to +105°C
Storage Temperature	-55°C to +150°C

8. Exceeding any one or combination of these limits may cause permanent damage to this device.
9. MACOM does not recommend sustained operation near these survivability limits.
10. Single event, up to 10 seconds duration.
11. Operating at nominal conditions with $T_J \leq +150°C$ (RX Mode) and $T_J \leq +125°C$ (TX Mode) will ensure MTTF >> 1 x 10^6 hours.
12. Operating/Case temperature (T_C) is the temperature of the exposed paddle.
13. Junction Temperature (T_J) = $T_C + \Theta_{JC} * P_{DISS}$ where P_{DISS} is the total DC & RF dissipated power.
    - RX Mode: Typical thermal resistance (Θ_{JC}) = 33.4 ºC/W.
    - TX Mode: Typical thermal resistance (Θ_{JC}) = 9.8 ºC/W.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

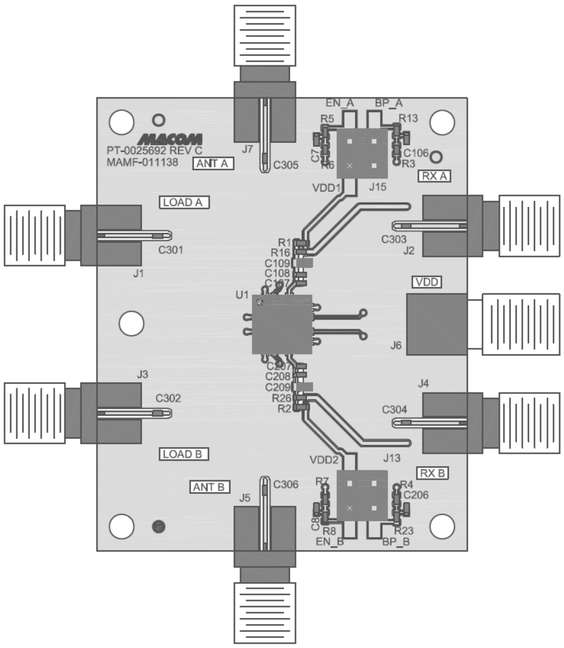
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Parameter	Rating	Standard
Human Body Model (HBM)	500 V Class 1B	ESDA/JEDEC JS-001
Charged Device Model (CDM)	1000 V (Class C3)	ESDA/JEDEC JS-002

Power Supplies

De-coupling capacitors should be placed at the V_{DD} supply pin to minimize noise and fast transients. Supply voltage change or transients should have a slew rate smaller than 1 V / 10 µs. In addition, all control pins should remain at 0 V (+/- 0.3 V) and no RF power should be applied while the supply voltage ramps or while it returns to zero.

PCB Layout

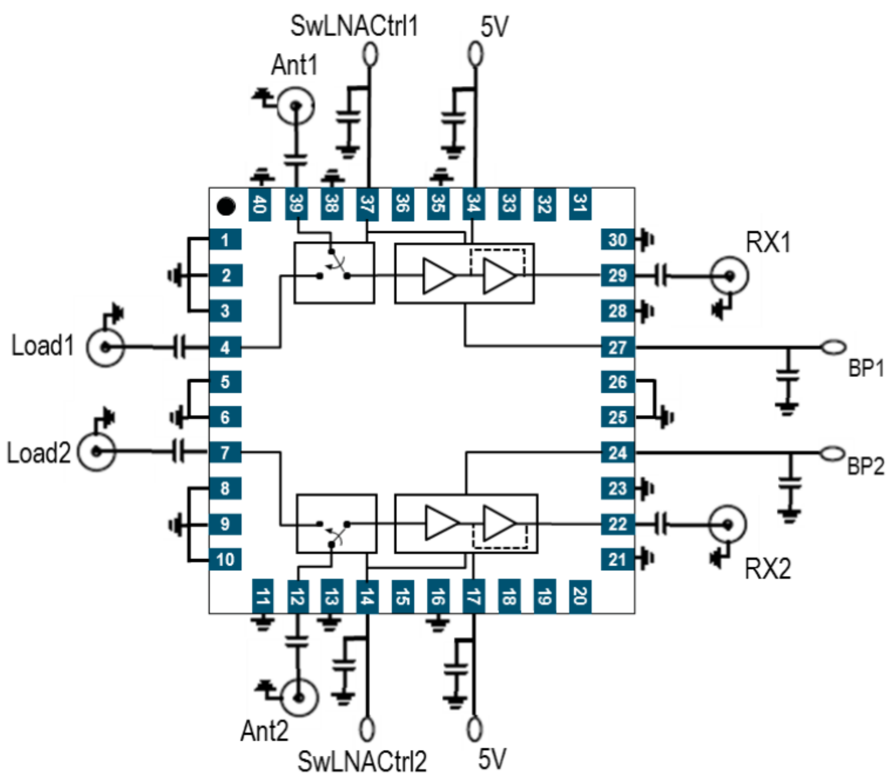


Parts List[14]

Part	Value	Case Style
C7, C8, C106, C206	5 pF	0402
C107, C207	470 pF	0402
C108, C208	10 nF	0402
C109, C209	10 µF	0603
C301 - C306	20 pF	0402
R1, R2, R3, R4, R6, R7	0 R	0402
R16, R26	DNP	0402
R5, R8, R13, R23	1 kΩ	0402

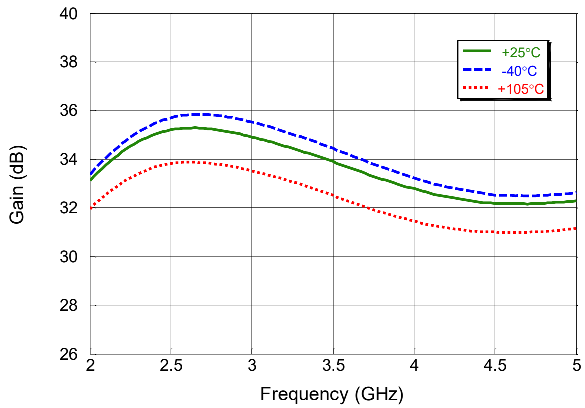
14. Proposed SMB parts list provides supply biasing for CH1 and CH2 via DC headers (J15/J13) with separate V_{DD1} and V_{DD2} supplies. A single V_{DD} supply may also be provided at the SMA connector (J6) by removing R1/R2 and populating R16/R26 with 0 R instead.

Application Schematic

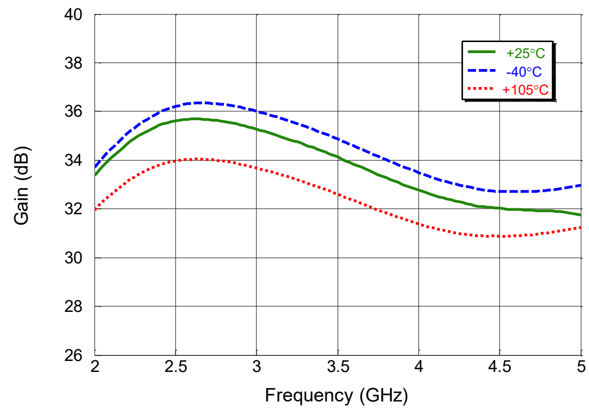


Typical Performance Curves:
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

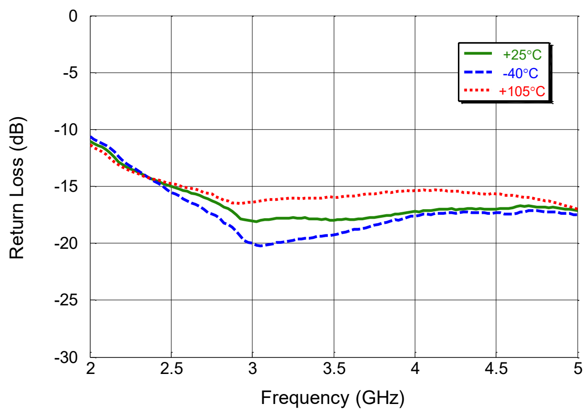
Channel 1 LNA Gain over swept Frequency (& Temp.) in Rx High Gain Mode



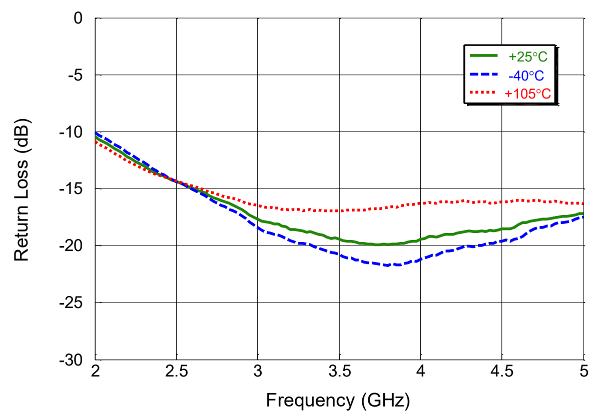
Channel 2 LNA Gain over swept Frequency (& Temp.) in Rx High Gain Mode



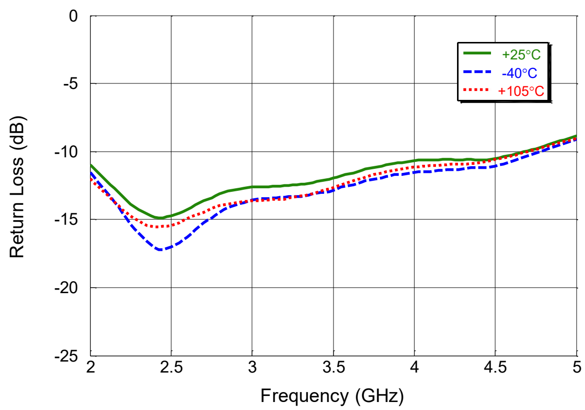
Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode



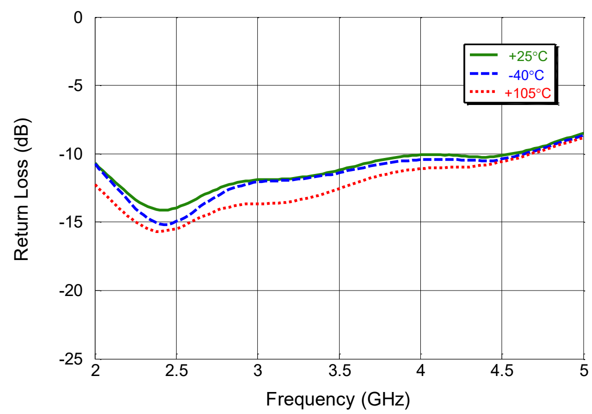
Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 1 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode

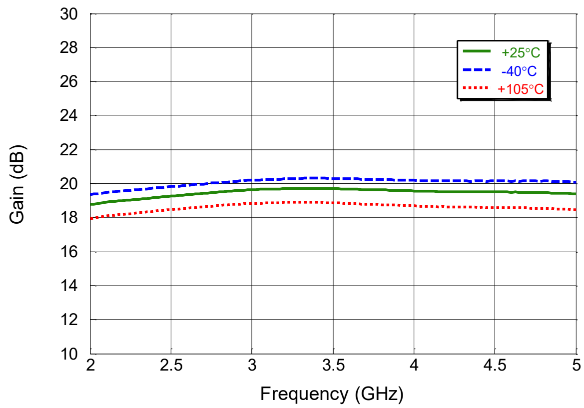


Channel 2 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode

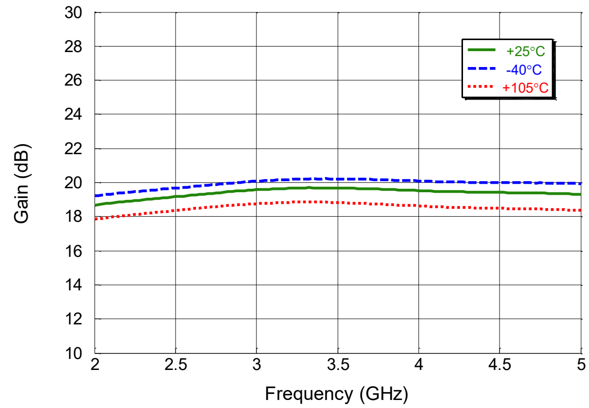


Typical Performance Curves:
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

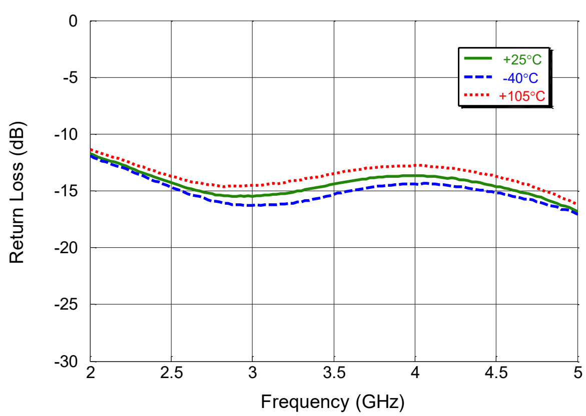
Channel 1 LNA Gain over swept Frequency (& Temp.) in Rx Low Gain Mode



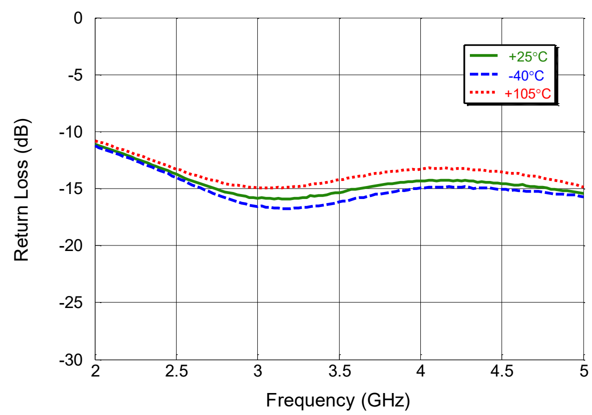
Channel 2 LNA Gain over swept Frequency (& Temp.) in Rx Low Gain Mode



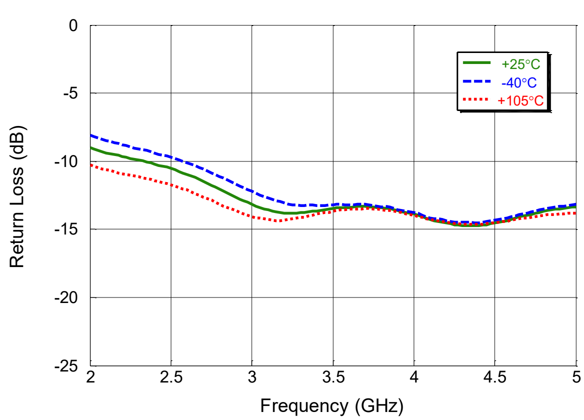
Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode



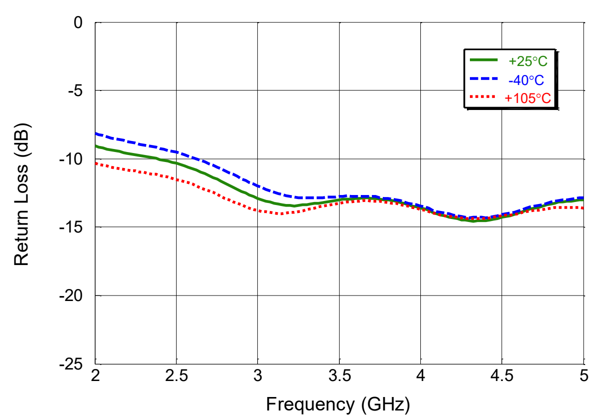
Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode



Channel 1 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode

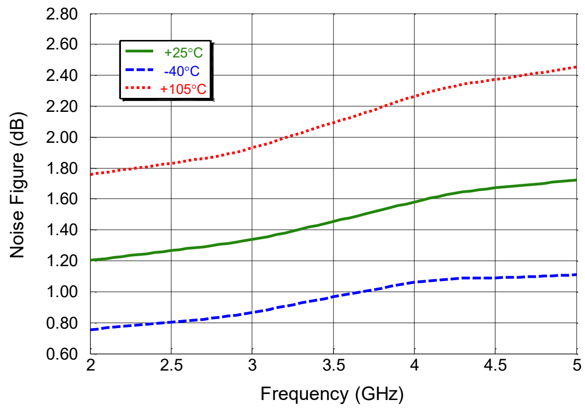


Channel 2 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode

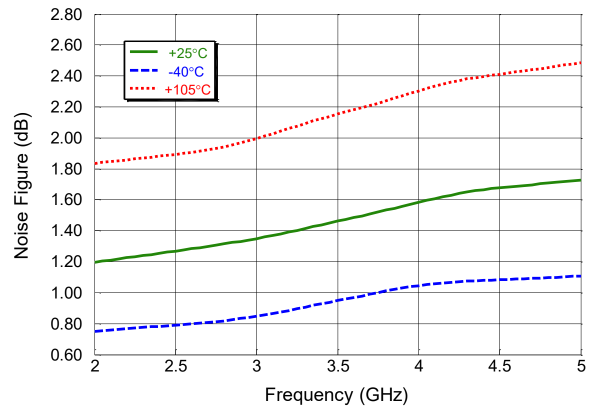


Typical Performance Curves:
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

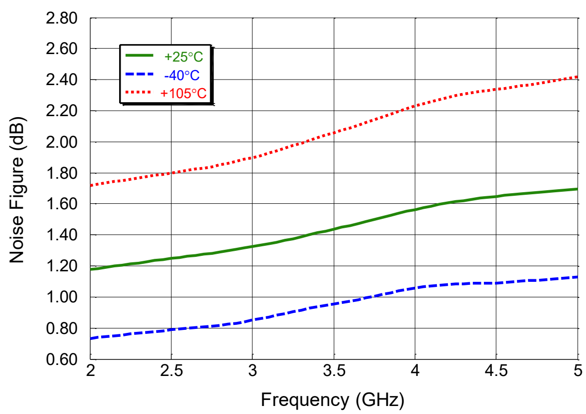
Channel 1 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode



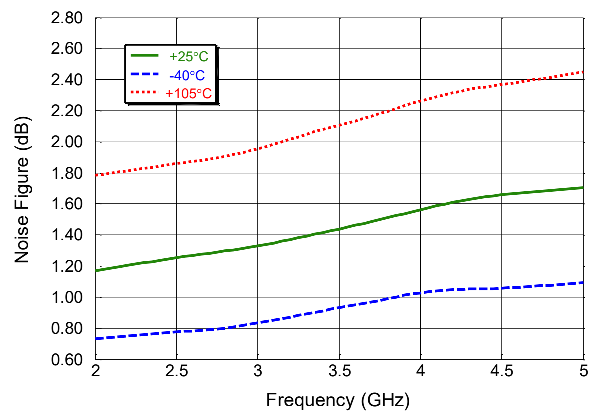
Channel 2 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode



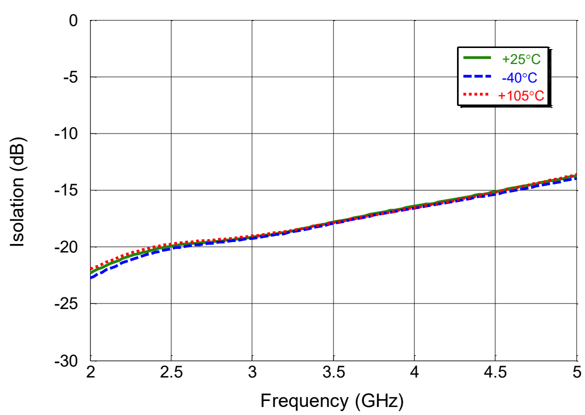
Channel 1 LNA Noise Figure over swept Frequency (& Temp.) in Rx Low Gain Mode



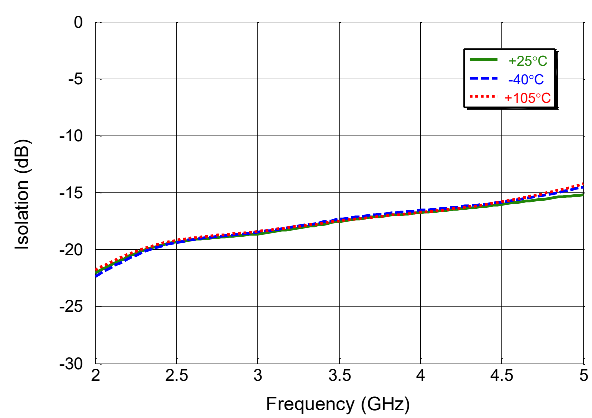
Channel 2 LNA Noise Figure over swept Frequency (& Temp.) in Rx Low Gain Mode



Channel 1 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 2 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx High Gain Mode



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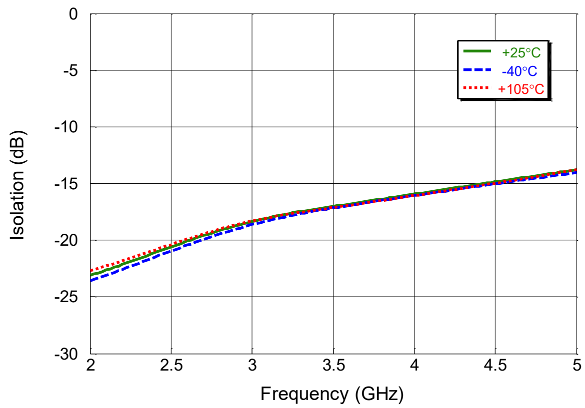
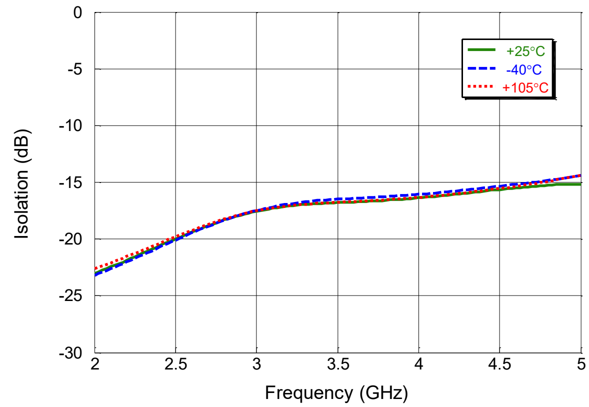
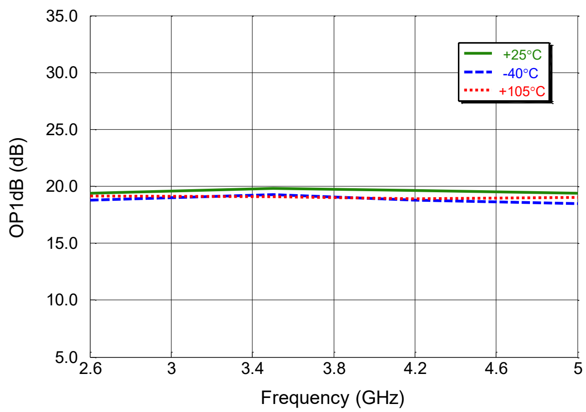
Channel 1 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx Low Gain Mode



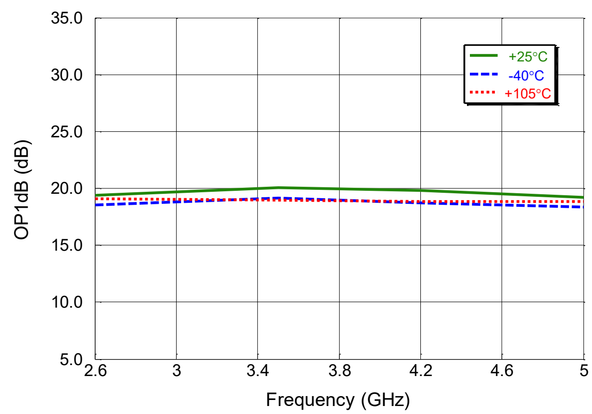
Channel 2 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx Low Gain Mode



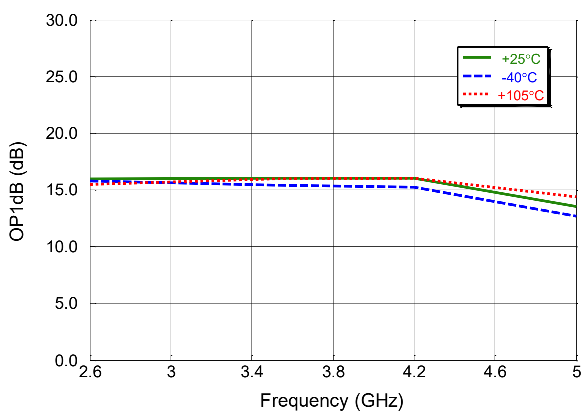
Channel 1 LNA Output P1dB over swept Frequency (& Temp.) in Rx High Gain Mode



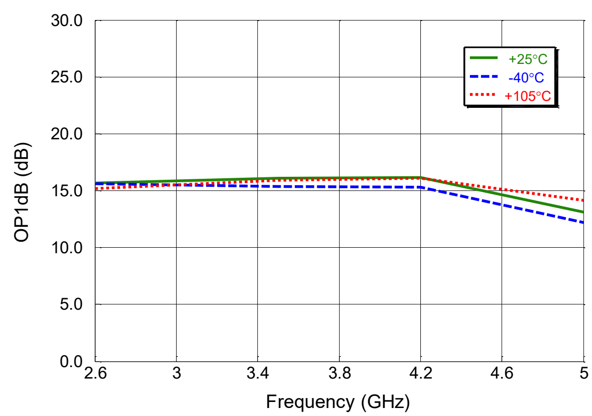
Channel 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 1 LNA Output P1dB over swept Frequency (& Temp.) in Rx Low Gain Mode.

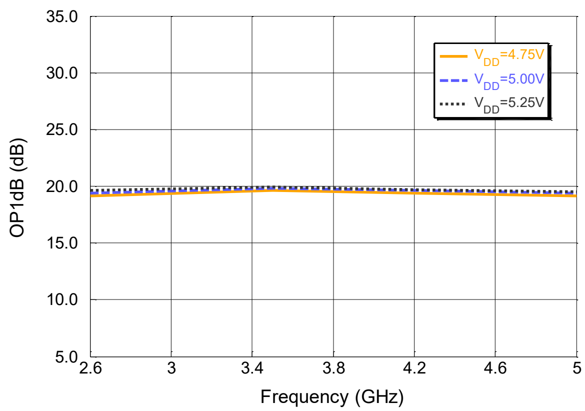


Channel 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx Low Gain Mode

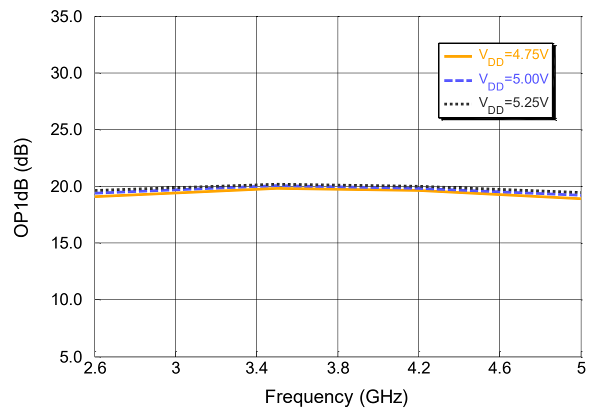


Typical Performance Curves:
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

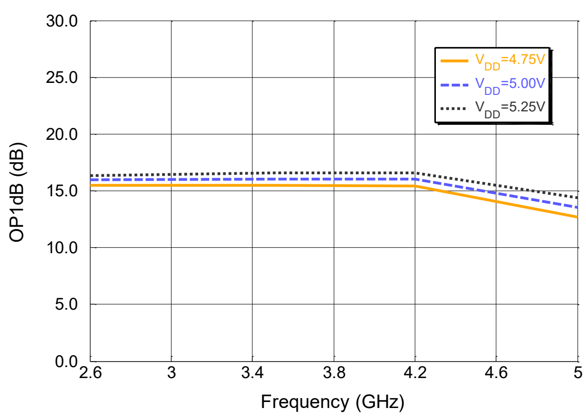
Channel 1 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx High Gain Mode



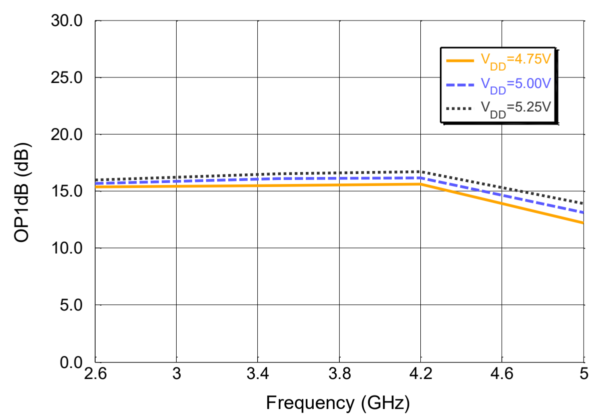
Channel 2 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx High Gain Mode



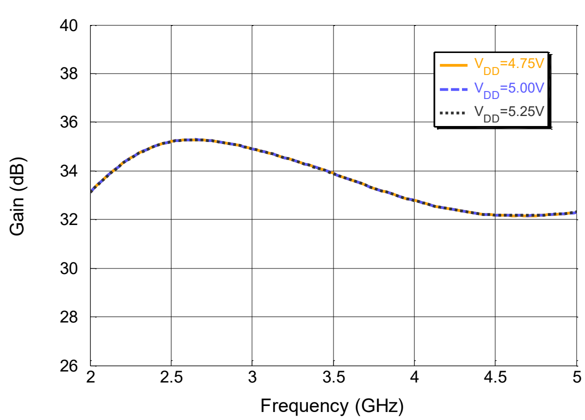
Channel 1 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx Low Gain Mode



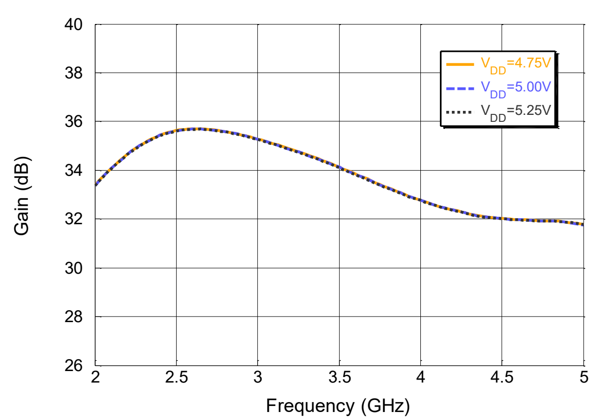
Channel 2 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx Low Gain Mode



Channel 1 LNA Gain over Frequency (& V_{DD}) in Rx High Gain Mode

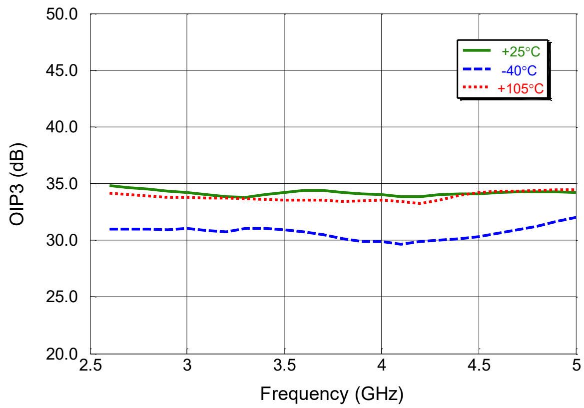


Channel 2 LNA Gain over Frequency (& V_{DD}) in Rx High Gain Mode

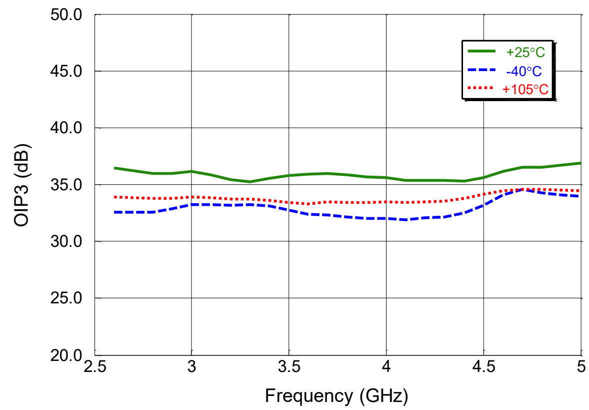


Typical Performance Curves:
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

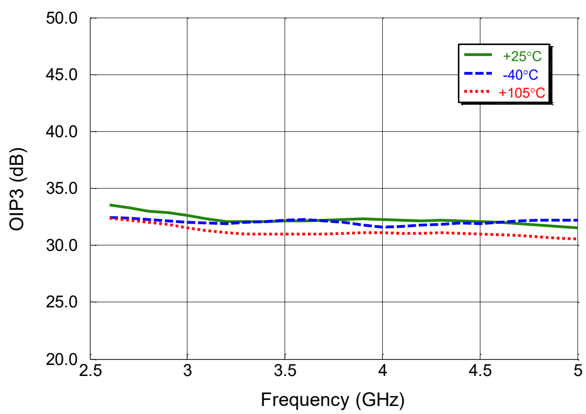
Channel 1 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 10 dBm & 10 MHz tone spacing in HGM.



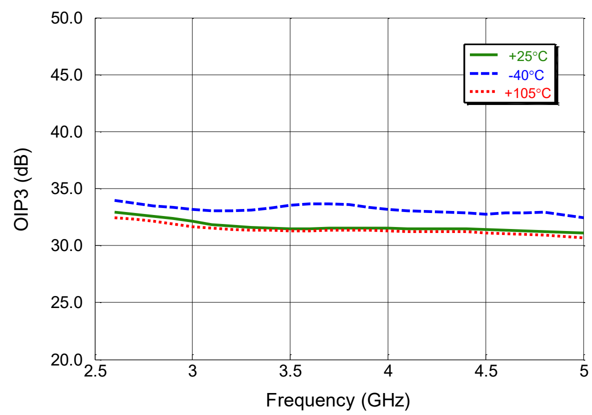
Channel 2 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 10 dBm & 10 MHz tone spacing in HGM.



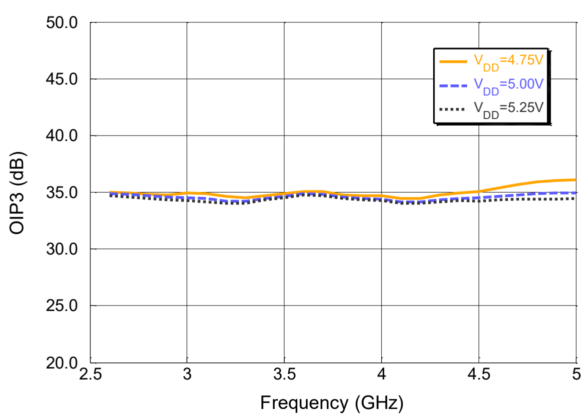
Channel 1 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 3 dBm & 10 MHz tone spacing in HGM.



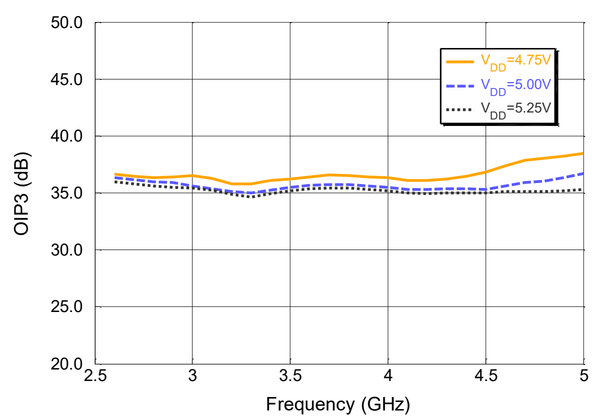
Channel 2 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 3 dBm & 10 MHz tone spacing in HGM.



Channel 1 OIP3 over swept frequency (& V_{DD}) with P_{OUT}/Tone = 10 dBm & 10 MHz tone spacing in HGM.



Channel 2 OIP3 over swept frequency (& V_{DD}) with P_{OUT}/Tone = 10 dBm & 10 MHz tone spacing in HGM.



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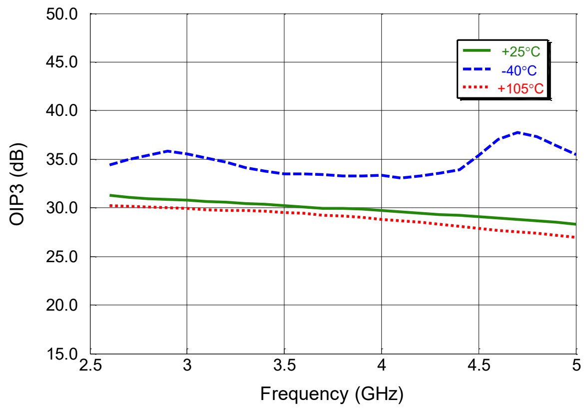
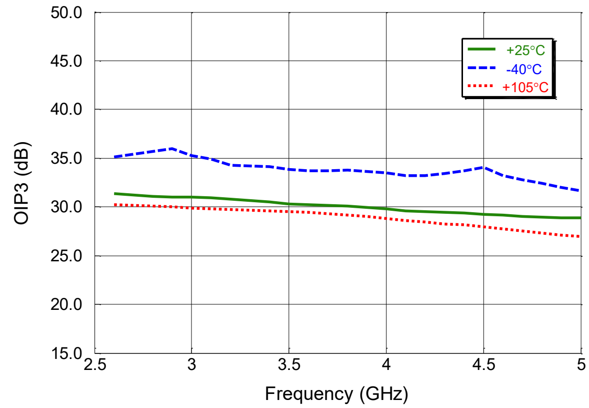
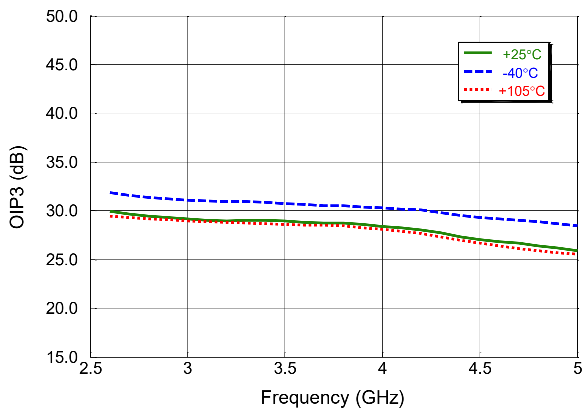
Channel 1 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 3 dBm & 10 MHz tone spacing in LGM.



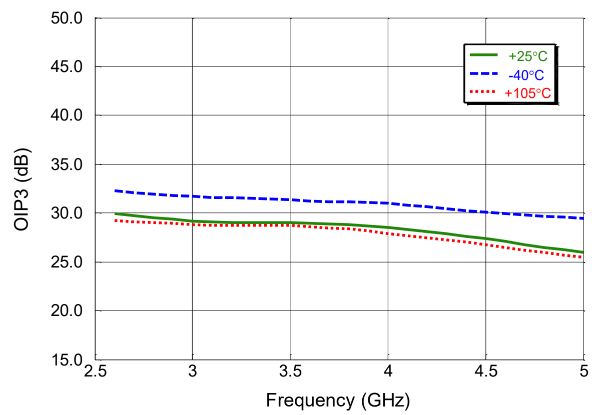
Channel 2 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 3 dBm & 10 MHz tone spacing in LGM.



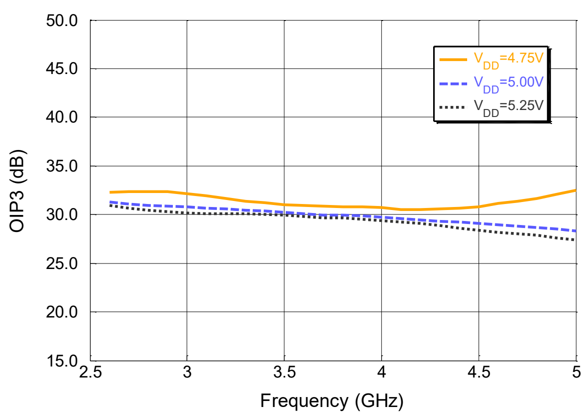
Channel 1 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 0 dBm & 10 MHz tone spacing in LGM.



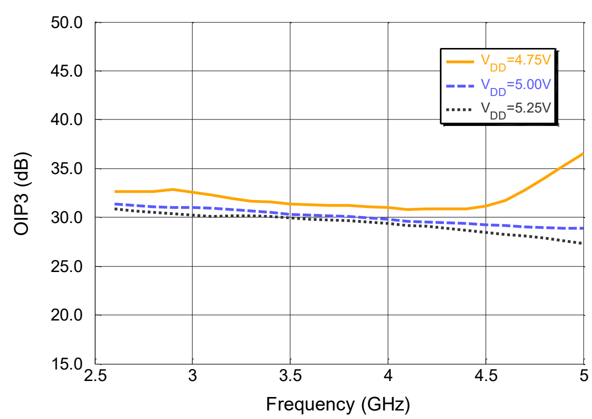
Channel 2 OIP3 over swept Frequency (& Temp.) with P_{OUT}/Tone = 0 dBm & 10 MHz tone spacing in LGM.



Channel 1 OIP3 over swept Frequency (& V_{DD}) with P_{OUT}/Tone = 3 dBm & 10 MHz tone spacing in LGM.

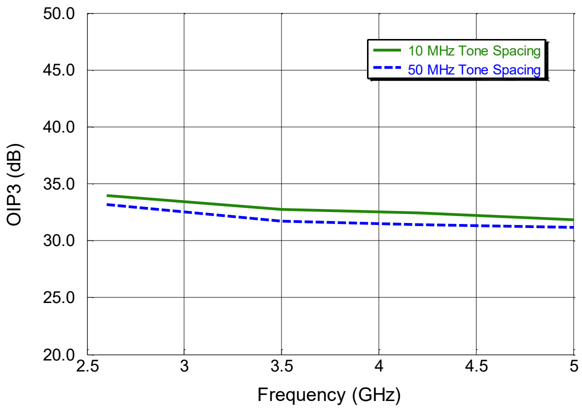


Channel 2 OIP3 over swept Frequency (& V_{DD}) with P_{OUT}/Tone = 3 dBm & 10 MHz tone spacing in LGM.

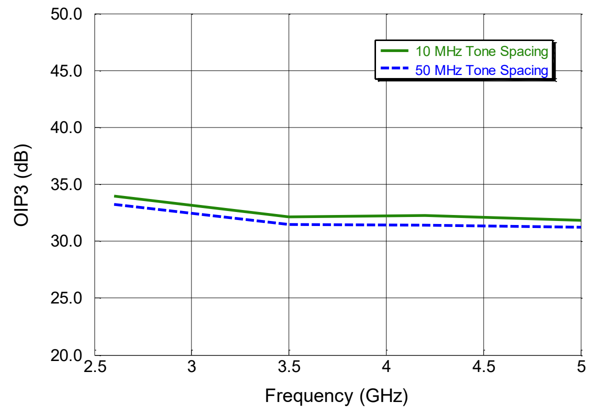


Typical Performance Curves:
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

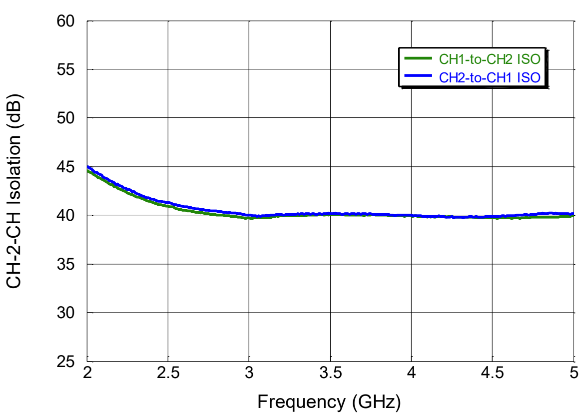
Channel 1 OIP3 over swept frequency with P_{OUT}/Tone = 6 dBm with 10 MHz & 50 MHz tone spacing in HGM.



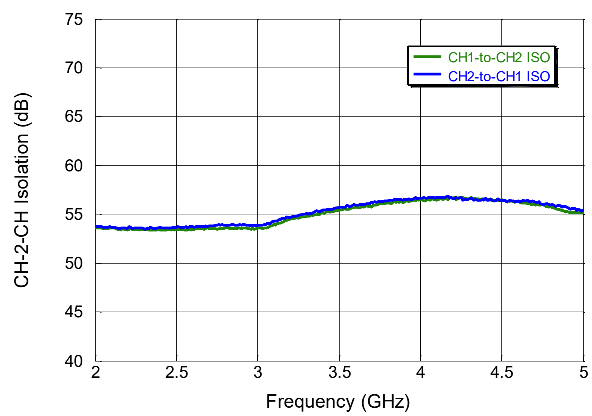
Channel 2 OIP3 over swept frequency with P_{OUT}/Tone = 6 dBm with 10 MHz & 50 MHz tone spacing in HGM.



Ch-2-Ch Isolation over swept Frequency in High Gain Mode

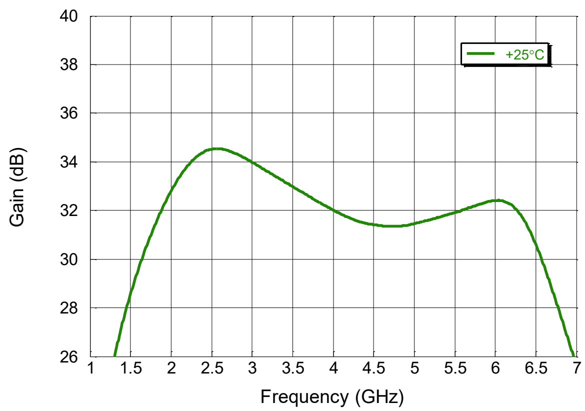


Ch-2-Ch Isolation over swept Frequency in Low Gain Mode

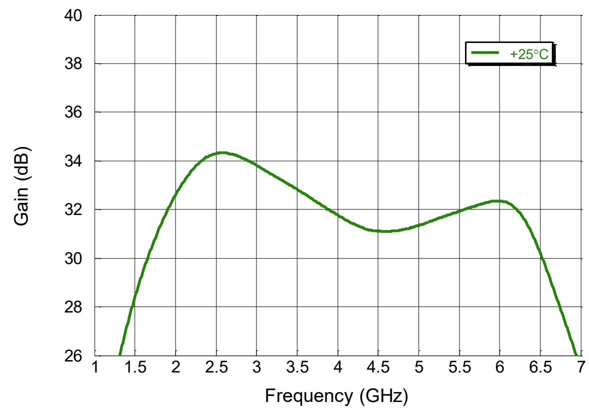


Typical Performance On Sample Board (No RF Connector/Trace Loss De-embedding)
P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

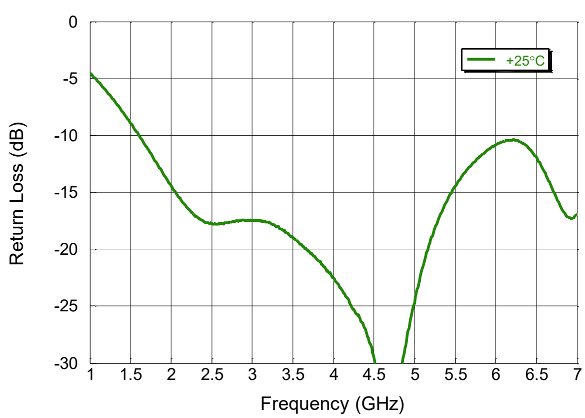
Channel 1 Wideband LNA Gain[15] over swept Frequency in Rx High Gain Mode



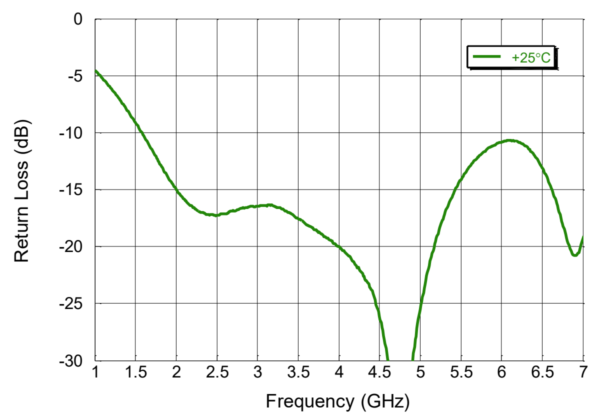
Channel 2 Wideband LNA Gain[15] over swept Frequency in Rx High Gain Mode



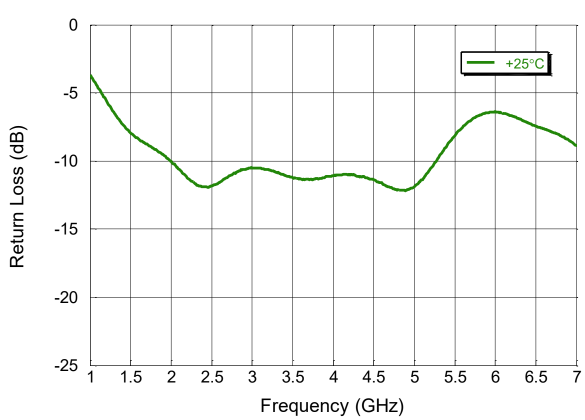
Channel 1 Wideband ANT Port Return Loss[15] over swept Frequency in Rx High Gain Mode



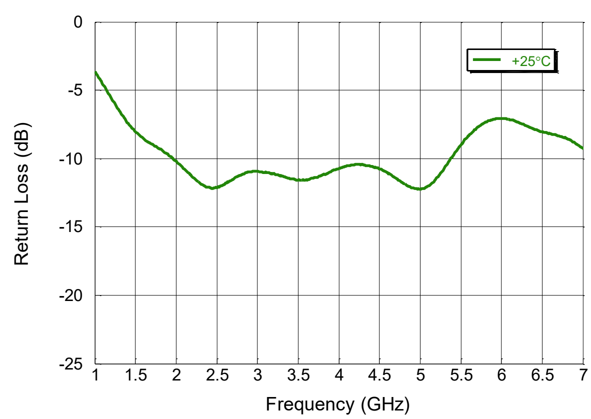
Channel 2 Wideband ANT Port Return Loss[15] over swept Frequency in Rx High Gain Mode



Channel 1 Wideband RXOUT Port Return Loss[15] over swept Frequency in Rx High Gain Mode



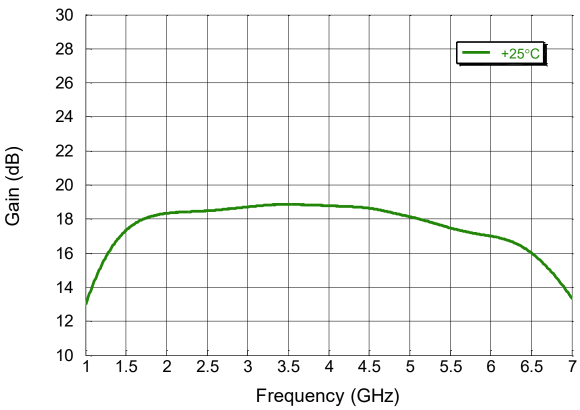
Channel 2 Wideband RXOUT Port Return Loss[15] over swept Frequency in Rx High Gain Mode



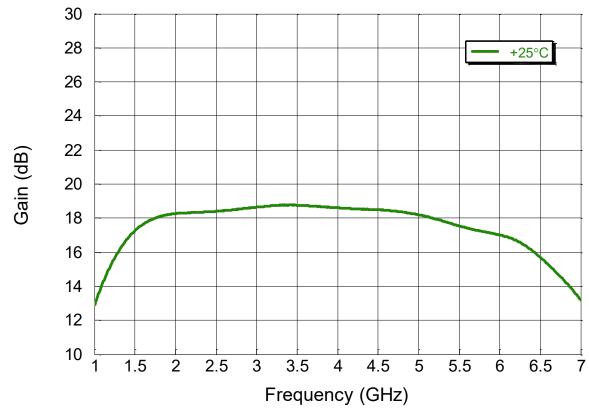
15. As measured at the Sample Board RF Launcher Reference Planes

Typical Performance On Sample Board (No RF Connector/Trace Loss De-embedding) P_{IN} = -35 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

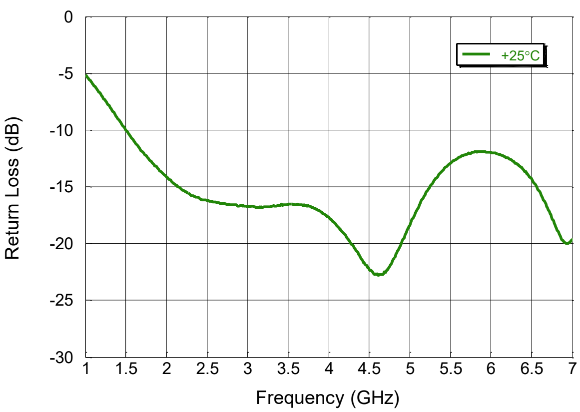
Channel 1 Wideband LNA Gain[16] over swept Frequency in Rx Low Gain Mode



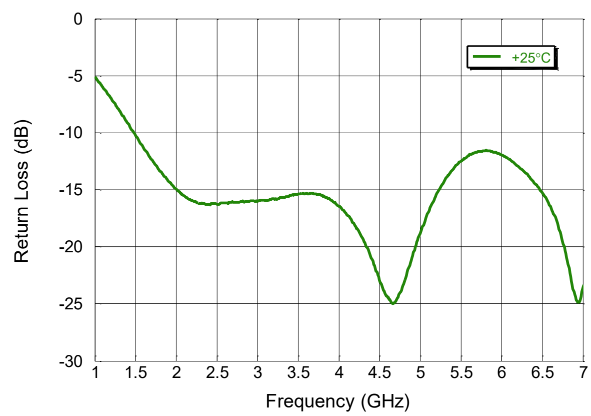
Channel 2 Wideband LNA Gain[16] over swept Frequency in Rx Low Gain Mode



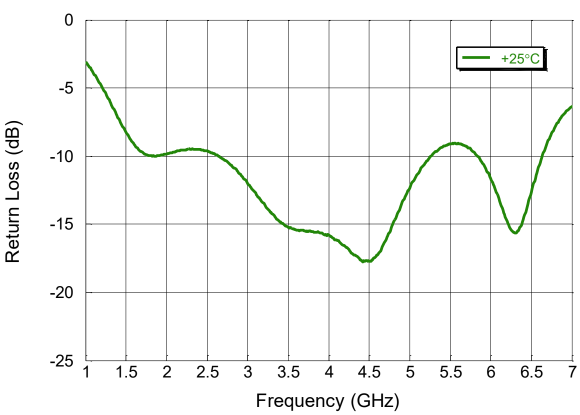
Channel 1 Wideband ANT Port Return Loss[16] over swept Frequency in Rx Low Gain Mode



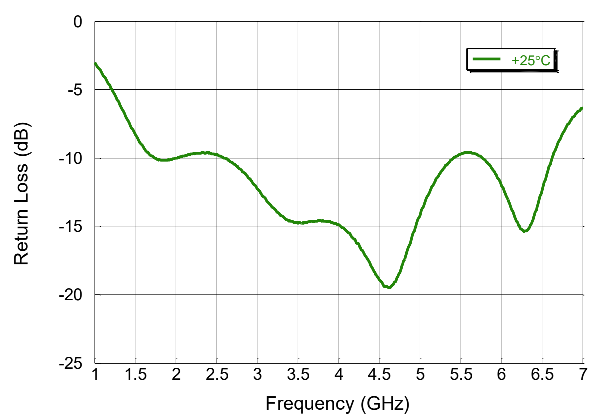
Channel 2 Wideband ANT Port Return Loss[16] over swept Frequency in Rx Low Gain Mode



Channel 1 Wideband RXOUT Port Return Loss[16] over swept Frequency in Rx Low Gain Mode



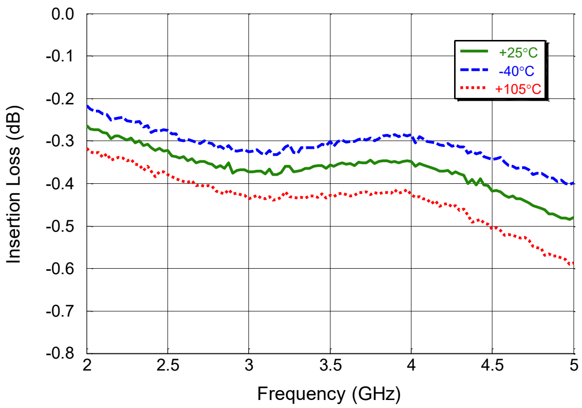
Channel 2 Wideband RXOUT Port Return Loss[16] over swept Frequency in Rx Low Gain Mode



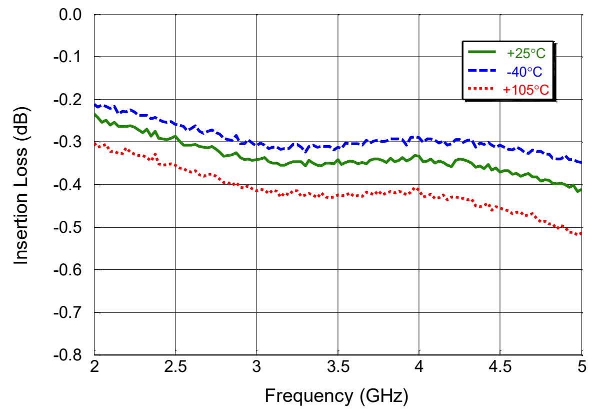
16. As measured at the Sample Board RF Launcher Reference Planes

Typical Performance Curves:
P_{IN} = -10 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

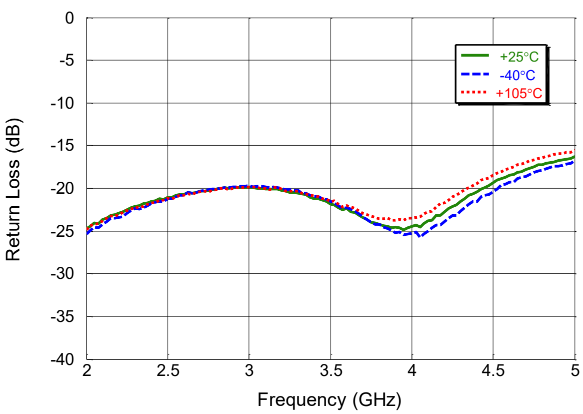
Channel 1 Switch Insertion Loss over swept Frequency (& Temp.) in Tx Mode



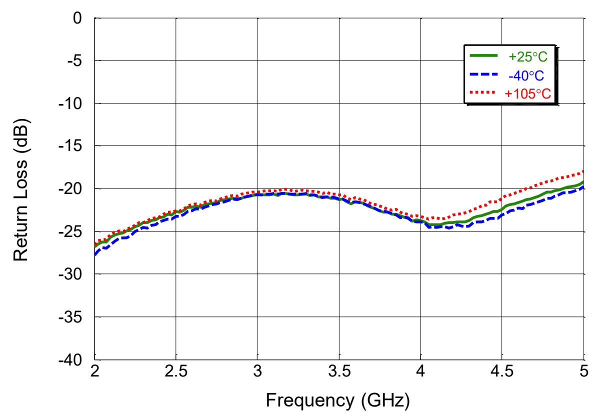
Channel 2 Switch Insertion Loss over swept Frequency (& Temp.) in Tx Mode



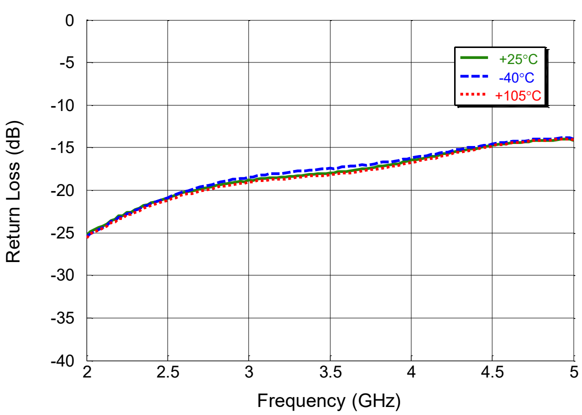
Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Tx Mode



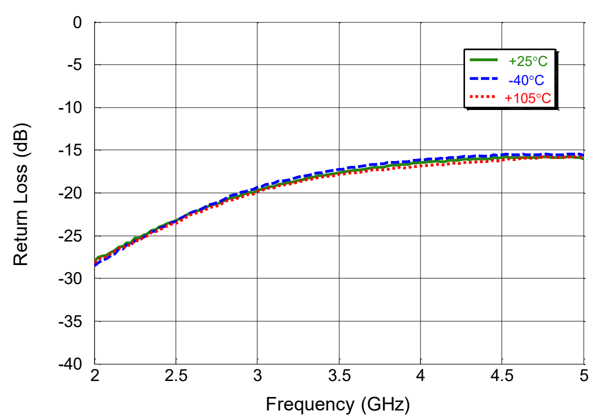
Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Tx Mode



Channel 1 LOAD Port Return Loss over swept Frequency (& Temp.) in Tx Mode

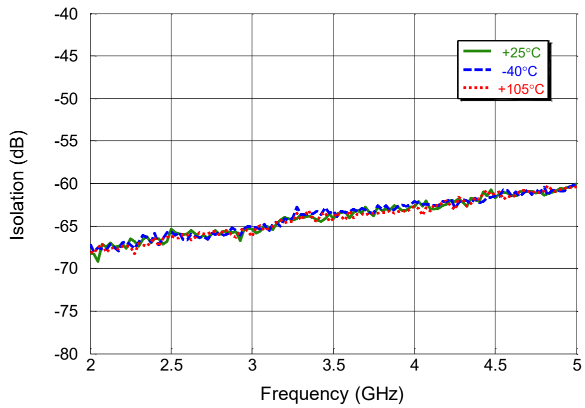


Channel 2 LOAD Port Return Loss over swept Frequency (& Temp.) in Tx Mode

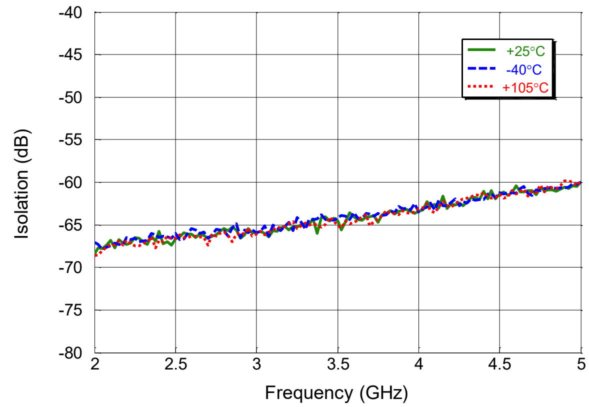


Typical Performance Curves:
P_{IN} = -10 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

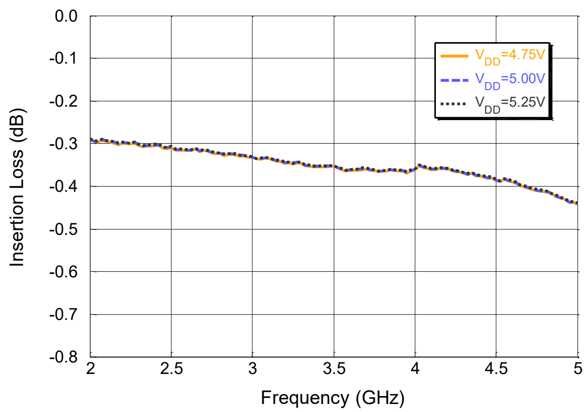
Channel 1 ANT to RXOUT Isolation over swept Frequency (& Temp.) in Tx Mode



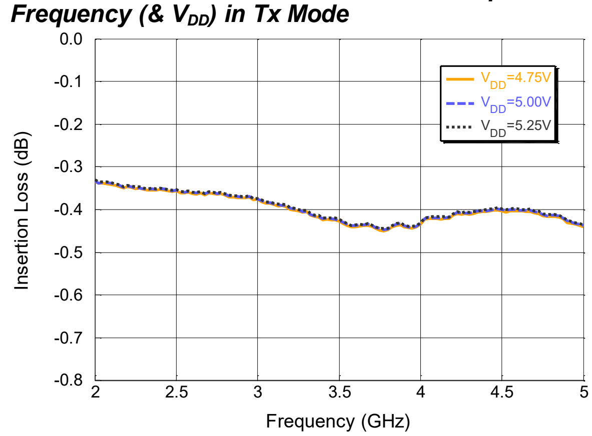
Channel 2 ANT to RXOUT Isolation over swept Frequency (& Temp.) in Tx Mode



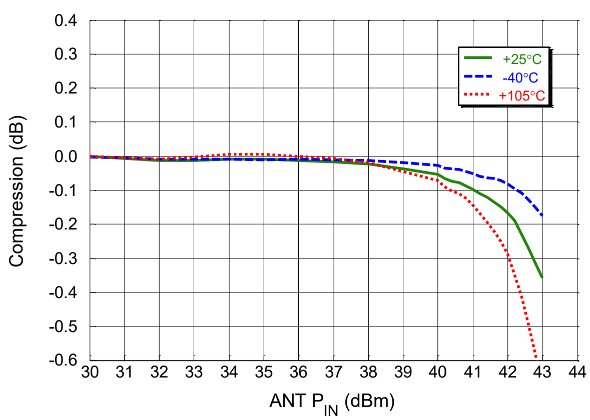
Channel 1 Switch Insertion Loss over swept Frequency (& V_{DD}) in Tx Mode



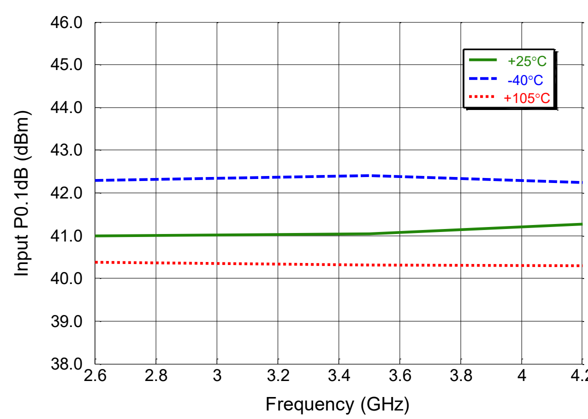
Channel 2 Switch Insertion Loss over swept Frequency (& V_{DD}) in Tx Mode



Switch Compression over swept ANT Input Power (& Temp.) at 2.6 GHz in Tx Mode

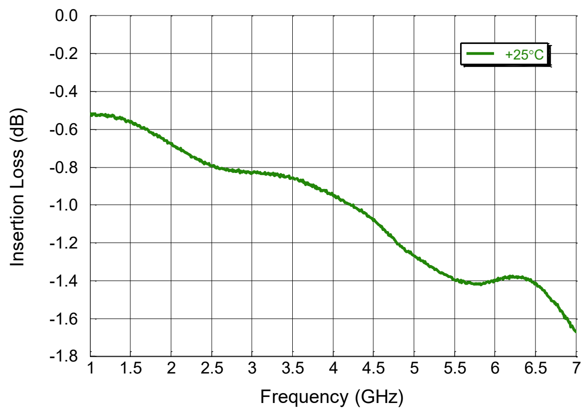


Switch ANT Input P0.1dB Compression Point over swept Frequency (& Temp.) in Tx Mode

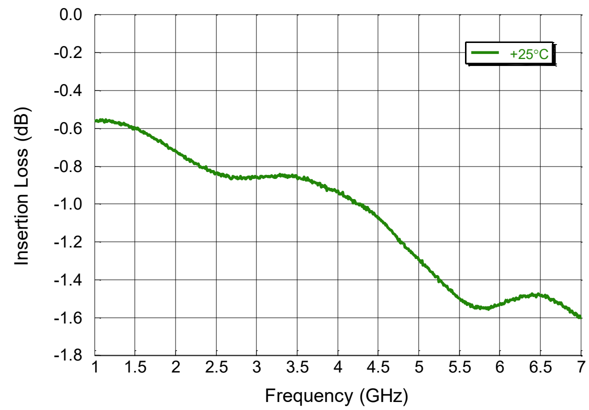


Typical Performance On Sample Board (No RF Connector/Trace Loss De-embedding)
P_{IN} = -10 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

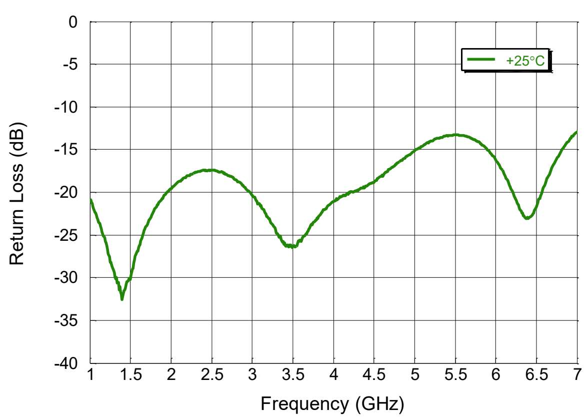
Channel 1 Wideband Switch Insertion Loss[17] over swept Frequency in Tx Mode



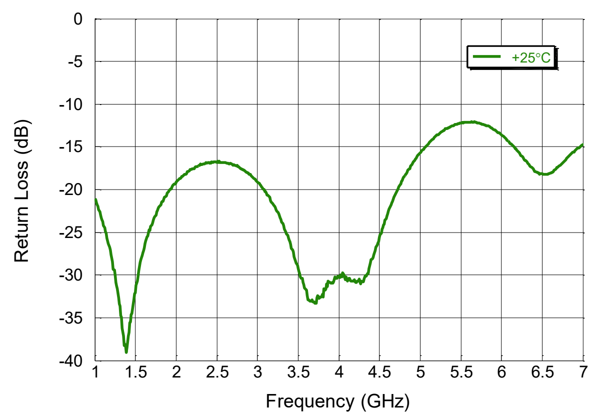
Channel 2 Wideband Switch Insertion Loss[17] over swept Frequency in Tx Mode



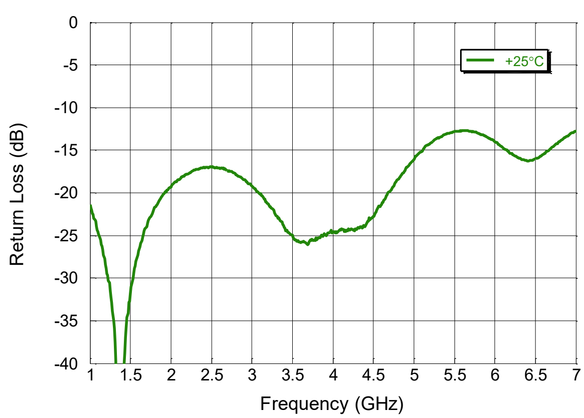
Channel 1 Wideband ANT Port Return Loss[17] over swept Frequency in Tx Mode



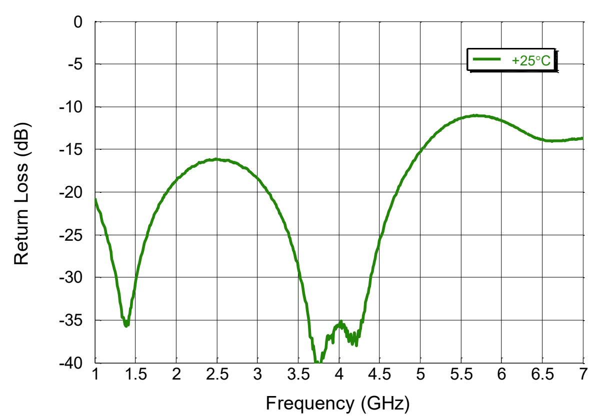
Channel 2 Wideband ANT Port Return Loss[17] over swept Frequency in Tx Mode



Channel 1 Wideband LOAD Port Return Loss[17] over swept Frequency in Tx Mode

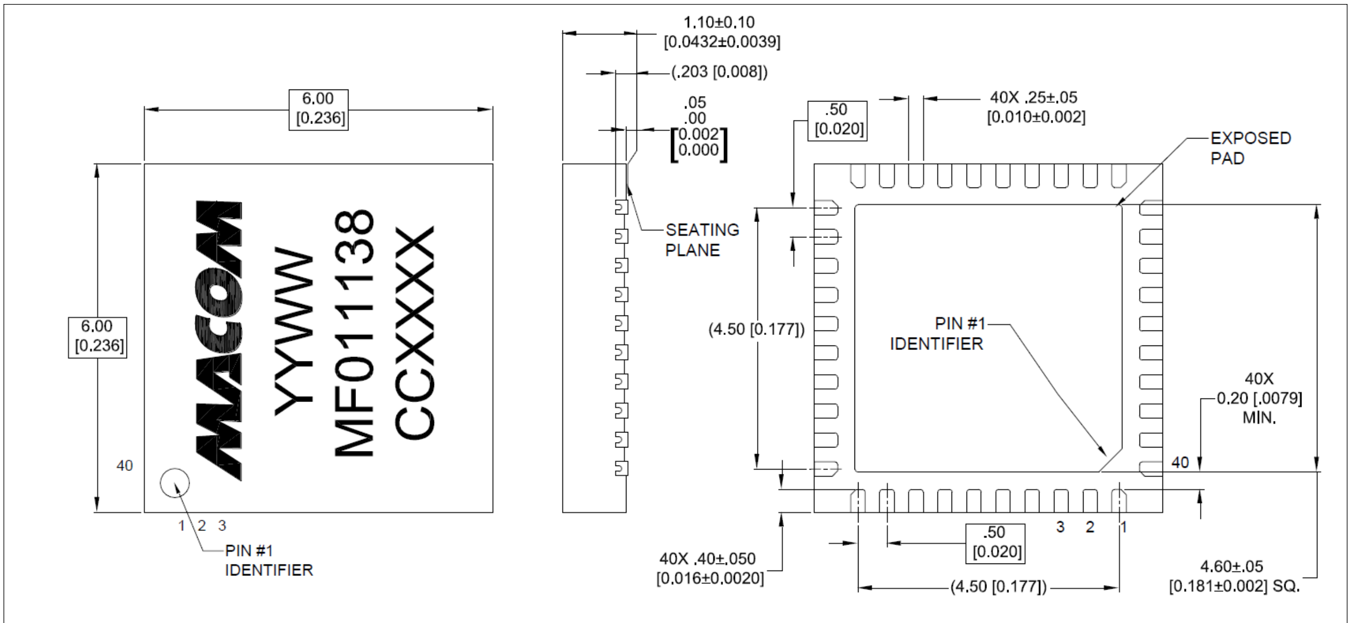


Channel 2 Wideband LOAD Port Return Loss[17] over swept Frequency in Tx Mode



17. As measured at the Sample Board RF Launcher Reference Planes

Lead-Free 6 mm 40-Lead QFN†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAuAg